SECTION 686—CONSTRUCTION SURVEYING

686.1 DESCRIPTION—This work is construction surveying for roadways, roadway appurtenances, and structures. This work is to preserve vertical and horizontal controls, and stationing throughout the construction phase up to and including final inspection, and to provide the Department inspection force with surveying control points to ensure quality of construction activities.

Construction surveying is classified into six types as follows:

(a) Construction Surveying, Type A. Surveying for new construction based on precise horizontal and vertical geometry established from surveys and 1:250 (25) scale or 1:500 (50) scale topographic mapping referenced to the National Geodetic Reference System/Pennsylvania State Plane Coordinate System.

(b) Construction Surveying, Type B. Surveying for reconstruction with the alignment based on, or related to, as-built plan horizontal and vertical geometry, or horizontal and vertical geometry produced on the existing roadway with minimal realignment. The planimetric features and cross sections may have been developed from mapping or by electronic surveying.

(c) Construction Surveying, Type B Modified. Surveying for reconstruction, the alignment may have been based on various alignment data such as:

- As built plan horizontal geometry, horizontal geometry, produced on the existing roadway;
- Random traverse baseline;
- Flatchain alignment along the center of the existing roadway; or
- A combination of horizontal geometry, random traverse base line, and flatchain alignment.

The vertical reference may have been based on:

- Plan profile or finish grade only;
- Cross sections related to the existing roadway section;
- Produced base line grades; or
- Templates based on the existing roadway cross sections.

(d) Construction Surveying, Type C. Surveying for general maintenance construction based on existing roadway alignment with no horizontal or vertical geometry. The drawings or detail sketches are developed using flatchain stations or segments/offsets for location reference. Grade and elevations relate to the existing roadway, unless otherwise indicated.

(e) Construction Surveying, Type D. Surveying for the construction or replacement of a bridge, culvert, arch, or special structure. The horizontal alignment is based on Second Order, Class II surveys, closure 1:10 000 (10,000:1). Reference all work points shown on the structure stakeout plan.

(f) Construction Surveying, Type D Modified. Surveying for the minor or major rehabilitation of a bridge, arch, or culvert. Bridge rehabilitation may involve repair or replacement of part of the substructure, or all or part of the superstructure. Rehabilitation of an arch or culvert may involve the repair or extension of the existing structure, or both.

686.2 MATERIAL—

(a) Tack. Standard Engineer's tack.

(b) Stake. Planed hardwood, 450 mm (18 inches).

(c) Hub. Planed hardwood, 450 mm (18 inches).

(d) Nail. Metal, 10 pennyweight.

(e) Guard Stake. Stake, 450 mm (18 inches), with space to identify the point guarded.

(f) Grade Point. Hub with Engineer's tack; or 60-pennyweight spike.

(g) Reference for Bridge. Hub with Engineer's tack, or iron pin with work center punch.

(h) Paint. Latex, yellow, orange, or white.

(i) Flat. Planed hardwood, 900 mm (36 inches).

(j) PK Nail. Hardened masonry nail.

(k) Flagging. Vinyl material.

(l) Benchmark Discs. Furnished by the Department.

686.3 CONSTRUCTION—

(a) General. The Department will provide all pertinent survey information at the preconstruction conference. Do not begin construction surveying until on or after the Notice to Proceed date. Upon completion of the survey work, return all survey information to the Representative.

The centerline or base lines, or both; side road and channel alignments; plan base lines; and interchange alignments will be established during project design. If there is an extensive time lapse between the design phase and the beginning of work, the Representative will refurbish the alignment by marking and placing new guard stakes at the pre-established control points.

The Contractor is responsible for verifying the alignment, grades, elevations, and dimensions indicated.

The Contractor is responsible for documenting any design error. Immediately notify the Representative of any error, omission, or discrepancy upon discovery.

Prior to removal of any existing benchmark disc(s), give the Representative written notice at least 3 weeks in advance of intent to remove the disc(s). Return the old disc(s) to the Representative.

Place the new benchmark disc(s) as directed, at a point that can be occupied by a survey level rod. Provide a written statement of completion to the Representative. The Representative will establish the new elevation on the new disc(s) and stamp the disc(s) accordingly.

Provide all construction surveying services, material, and equipment needed to stake, mark, reference, and monitor the project. Provide the Representative with any assistance requested for verification of lines, grades, widths, elevations, and measurements or for QA verification. Record geometric or coordinate ties on all lines produced.

All survey activities will be performed according to the standards set forth in Publication 122M, the Department’s Surveying and Mapping Manual.

Employ a Professional Land Surveyor or Professional Engineer, registered in the State, qualified in the use of highway and bridge plans; cross sections and specifications; and procedures for establishing line and grade, structure locations, and dimensions, as may be required. Assume full responsibility for dimensions and elevations taken from control stakes and for the setting of structure location and line and grade stakes.

For Type A, Type B, Type B Modified, Type D, and Type D Modified construction surveying provide a surveyor or engineer, to work under the direction of the registered Professional Land Surveyor or Professional Engineer. This individual shall have as a minimum, highway surveying knowledge, skills, and abilities equivalent to those of the State's Surveyor Technician Supervisor Job Classification, or have experience in the prerequisite work elements of the NICET Transportation Engineering Technician/Highway Surveys Level III Technician.

References to "minor structure work" or "minor roadway work" refer to structure or roadway work representing 20% or less of the total contract price.

For all projects, including those with unsuitable and borrow excavation material, the Department will provide all cross sections needed to compute quantities for payment purposes.

(b) Construction Surveying, Type A. The centerline or base lines, or both; side road and channel alignments; plan base lines; and interchange alignments will be established, on the ground, at major control points. The maximum interval between referenced major control points will not exceed 300 m (1,000 feet). All major control points will be referenced and vertical benchmarks will be established at appropriate locations.

The Contractor is responsible for the construction stakeout of the project, using the horizontal and vertical control established by the Department.

The Contractor is responsible for relocation and/or preservation of all horizontal references of major control points and vertical benchmarks established by the Department.

Provide the Representative with a comprehensive stakeout schedule for development of the project, listing areas or grading sections by plan designation or station location.

The Contractor is responsible for checking the cross section (original ground and template intersection) on each side of the grade point(s) at each station for accuracy and acceptance. In case of any cross sectional or template discrepancy, forward documentation to the Representative.

Where the finished grade is 1.5 m (5 feet) or more vertically above or below existing grade, place an offset grade point with a guard stake at right angles to the centerline or base line controlling the grade point(s), or at 90 degrees from the tangent to the curve, at each 40 m (100-foot) station. Offset grade points from the intersection of the cross section template and original ground. Mark guard stakes according to the rounding, station, offset right or left of centerline/base line, and offset from the intersection of the template and original ground.

Establish a finished grade control line offset, parallel to the centerline or base line, by setting grade points at 20 m (50-foot) intervals. Establish grade points at 10 m (25-foot) intervals for arcs/curves equal to or less than 100 m radius (of 16 degrees or greater).

Furnish the Representative with grade sheets for all grade points and finish grade points. Show the grade point elevation, finish grade elevation, and offset right or left of the grade point or finish grade point from the centerline or base line on Form D-413.

The Contractor is responsible for staking the plan alignments and grade points for temporary construction easements and temporary roadways or crossovers.

The Contractor is responsible for staking legal right-of-way lines and temporary easement lines if required.

Provide the Representative with all coordinate networks used in staking the project, including coordinate geometry, horizontal geometry, and referenced network points.

(c) Construction Surveying, Type B. Provide this type of surveying for roadway construction with minor structure work. Construction surveying required for the minor structure work, if any, is incidental. Perform incidental surveying as specified for the applicable type.

The centerline or base lines, or both, and side road and channel alignments will be established on the ground, at major control points. The maximum interval between referenced major control points will not exceed 300 m (1,000 feet). All major control points will be referenced and vertical benchmarks will be established at appropriate locations.

The Contractor is responsible for the construction stakeout of the project, using the horizontal and vertical control established by the Department.

The Contractor is responsible for relocation and or preservation of all horizontal references of major control points and vertical benchmarks established by the Department.

Establish all base lines, grade lines, parallel lines, traverse lines, and reference lines deemed necessary by the Engineer to control construction operations.

The Contractor is responsible for staking the plan alignment and grade for temporary roadways and crossovers.

The Contractor is responsible for staking legal right-of-way lines and temporary easement lines as required to construct the project. Stake the lines based on plan data.

Provide the Representative with all coordinate networks used in staking the project, including coordinate geometry, horizontal geometry, and reference network points.

(d) Construction Surveying, Type B Modified. Provide this type of surveying for roadway construction with minor structure work. Construction surveying required for the minor structure work, if any, is incidental. Perform incidental surveying as specified for the applicable type.

The centerline or base lines, or both, will be established on the ground at major control points. Vertical control will be established at appropriate locations.

Legal right-of-way lines or temporary easement lines will be established, as required, at project locations controlled by flatchain stations. The Department will stake R/W on flatchain projects, if curved alignments or complex configurations are beyond the scope of the flatchain survey.

The Contractor is responsible for the construction stakeout of the project, using the alignment established by the Department.

The Contractor is responsible for the relocation or preservation, or both, of any major control point or vertical benchmark.

The Contractor is responsible for placing and maintaining all grade points, guard stakes, nails, hubs, or paint marks necessary to control construction of the project.

The Contractor is responsible for staking plan alignment and grade for temporary roadways and crossovers.

The Contractor is responsible for staking legal right-of-way lines or temporary easement lines where controlled by horizontal geometry. Stake the lines based on plan data.

(e) Construction Surveying, Type C. Only the limits of work will be established by marking the beginning and ending station, or the beginning and ending segments and offsets. The limits of work will be established only once during the life of the Contract.

For Group Contracts, the limits of work will be established using State Route and segment markers.

Establish the stationing or segments and offsets, or both, at 40 m (100-foot) intervals, between the limits of work, by flatchain measurements. Establish stationing at the centerline or edges of pavement with paint marks, or by placing stakes at right angles to the station or segment/offset.

Place additional stakes or marks as necessary to control construction operations.

(f) Construction Surveying, Type D. Provide this type of surveying for structure construction with minor roadway work. Construction required for the minor roadway work, if any, is incidental. Perform incidental surveying as specified for the applicable type.

All centerline or base line, or both, structure control points will be established on the ground.

The Contractor is responsible for the construction stakeout of bridges, arches, culverts, and other special structures, as required to facilitate and control the work, using the horizontal and vertical control established by the Department.

Review, with the Representative, the structure stakeout plan sheet designating work points to be referenced, before performing the field stakeout.

Obtain approval for any variance or exception to the field stakeout plan, before performing the work.

Reference all designated work points. Reference each work point on a direct line through any adjacent work point(s). Establish three reference points for the work point at each corner of abutments and at each end of wingwalls. Establish three reference points for work points on proprietary or other walls. For land piers, establish three reference points, on each side of the substructure, for work points on the centerline of bearing. The distance between a work point and its first reference point is to be less than 30 m (100 feet), with the exception of centerline pier reference.

Establish a Second Order, Class II traverse network, at each structure site, coordinating abutment and pier reference. Show the precision ratio, and comparisons of longitudinal distances.

Furnish the Representative prior to any structure construction activities with a field stakeout sketch, based on the structure plan stakeout, showing only centerline/base line stations, span lengths, reference angles, and reference lengths. Show two described vertical benchmarks.

Furnish the Representative prior to any structure construction activities with a sketch showing a triangulation network or traverse network at each structure site. For water-bound piers, include base line control showing length of sides “a” and “b” and interior angles A and B.

Include the date, structure description, Contractor's name, and person responsible for the stakeout, on field stakeout sketches.

(g) Construction Surveying, Type D Modified. Provide this type of surveying for structure construction/rehabilitation with minor roadway work. Construction surveying required for the minor roadway work, if any, is incidental. Perform incidental surveying as specified for the applicable type.

All centerline or base line, or both, structure control points will be established on the ground.

The Contractor is responsible for the construction stakeout of the structure rehabilitation, using the horizontal and vertical control established by the Department.

Review, with the Representative, the structure stakeout plan sheet designating the work points to be referenced, before performing the field stakeout.

Reference all designated work points. Reference each work point on a direct line through any adjacent work point(s). Establish three reference points for the work point at each corner of abutments and at each end of wingwalls. For land piers, establish three reference points, on each side of the substructure, for work points on the centerline of bearing or as indicated on the structure plan stakeout. The distance between a work point and its first reference point is to be less than 30 m (100 feet), with the exception of pier reference. For water-bound piers, use base line reference.

Furnish the Representative prior to any structure construction activities with a field stakeout sketch, based on the structure plan stakeout, showing reference points, lengths, vertical control, and pertinent plan data.

Furnish the Representative prior to any structure construction activities with a separate sketch showing a triangulation network or traverse network, or methodology for a mathematical check of the survey produced.

686.4 MEASUREMENT AND PAYMENT—

(a) Construction Surveying. Lump Sum

For the type indicated.

The Department will pay for this item as specified in Section 110.05, in four payments, according to the following schedule:

- When work representing 10% of the total contract price is completed, excluding the bid price for this item, the Department will pay 25% of the amount bid for this item.
- When work representing 30% of the total contract price is completed, excluding the bid price for this item, the Department will pay 25% of the amount bid for this item.
- When work representing 90% of the total contract price is completed, excluding the bid price for this item, the Department will pay 20% of the amount bid for this item.
- Upon completion of the project, the Department will pay the remaining 30% of the amount bid for this item.

(b) Unidentified Work. The Department will pay for unidentified work as follows:

1. Negotiated Price. At an agreed upon price. The Department and the Contractor will agree upon this price before performing the work.

2. Force Account Basis. Section 110.03(d)